

NRC Medium Voltage Circuit Breaker Training



CHAPTER 9

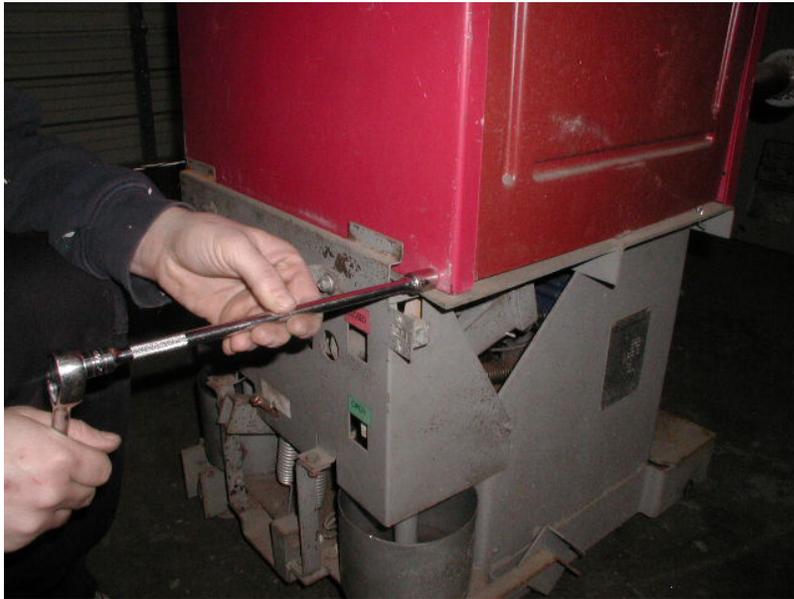
INTRODUCTION TO ALLIS- CHALMERS MA CIRCUIT BREAKERS

Learning Objectives



- The basic function of the MA circuit breaker.
- How the MA breakers are classed or grouped.
- How the breaker frame size method further identifies the breaker.
- The component attributes of the MA breaker:
 - Chassis Mounting Arrangement
 - Primary Circuit, Support Assemblies and Arc Chutes
 - Electrical Devices including wiring
 - Mechanical and Safety Interlocks
 - Operator Assembly and Jackbar
 - Puffer Assembly
- Basic understanding of maintenance scheduling.
- Basic understanding of subcomponent replacement.
- Basic understanding of design upgrades for the MA breakers.
- Proper lubrication type for MA breakers.
- Basic understanding of routine maintenance using the Preventative Maintenance Manual for the MA Circuit Breaker.

WHAT IS AN ALLIS-CHALMERS CIRCUIT BREAKER



- Allis Chalmers was the original name of the manufacturer of the MA style breaker they became Siemens Allis in 1978 and are now Siemens. In the 1960's they developed the MA, FB and FC series of circuit breakers.

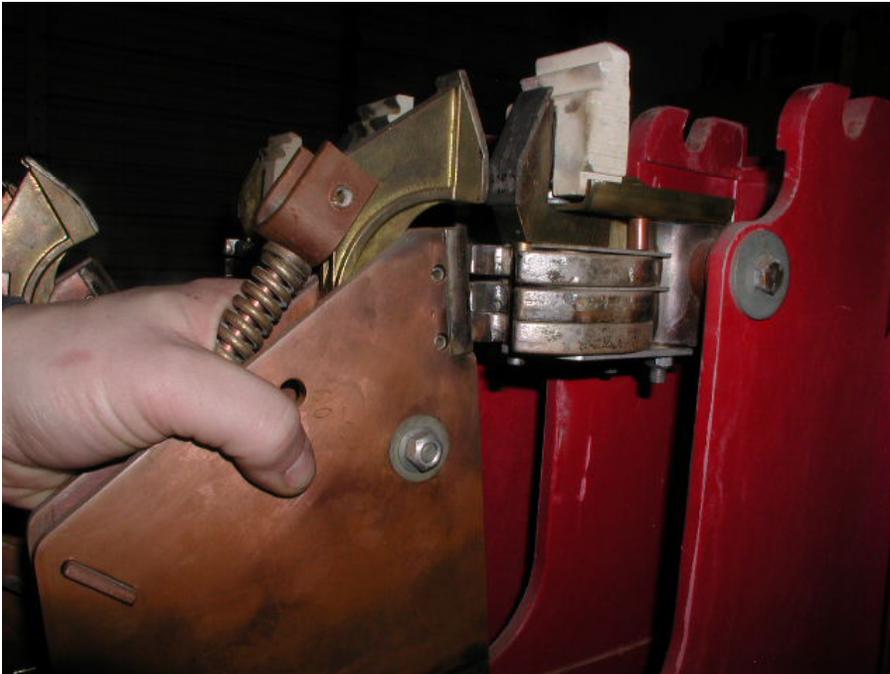
WHAT IS AN ALLIS-CHALMERS CIRCUIT BREAKER



- The MA breaker was the first series in the design that eventually became FC. The MA breaker is classed by Voltage class, Ampere size and Interrupting capacity. The 5KV MA models include the MA-75, MA-150, MA-250 and the MA-350 with continuous currents of 1200A and 2000A.

PRIMARY CONTACT ASSEMBLY FOR THE MA BREAKER

- Stationary Arcing Contacts



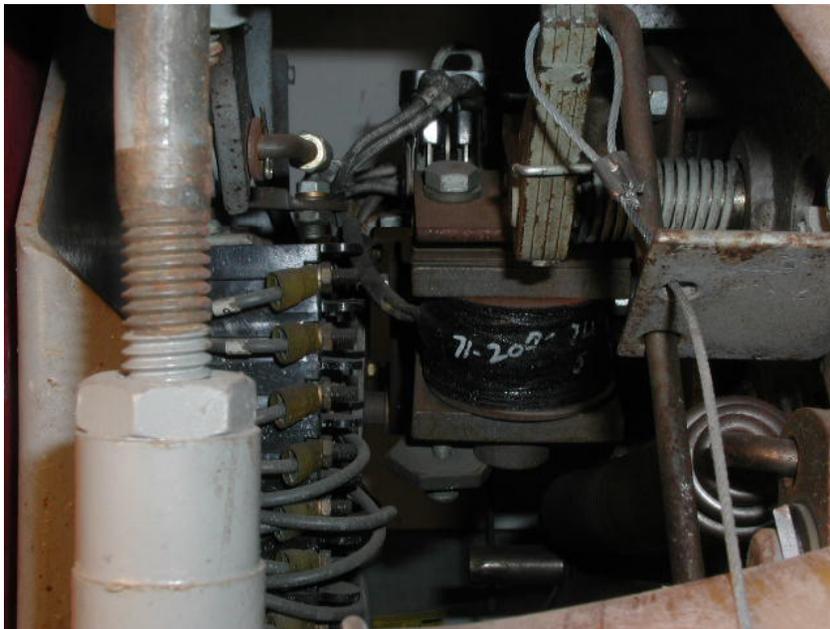
Designed to withstand the energy of the arc when the breaker opens under load. Typically made of a Silver Tungsten alloy or similar material. Arcing contacts always "MAKE" first and "BREAK" last.

COMMON ELECTRICAL DEVICES FOR THE MA BREAKER



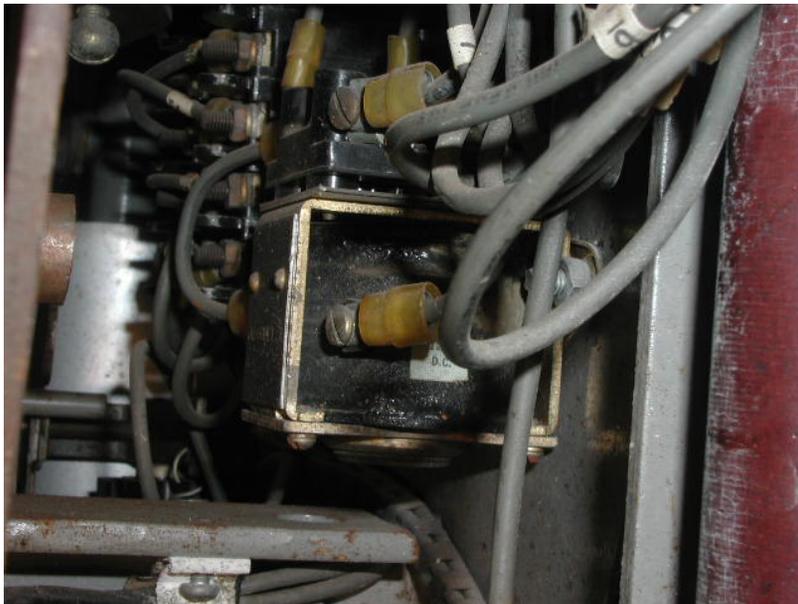
Auxiliary Switch- There is one switch with 8 contacts (4 N/C and 4 N/O on the switch) with an actuator linkage connected to the jackbar. The Auxiliary switch provides remote indication of breaker status and a permissive path to the Shunt Trip Coil, allowing the breaker to OPEN electrically. The switch consists of both "A" and "B" contacts. "A" contacts are OPEN when breaker is OPEN and CLOSED when the breaker is CLOSED. "B" contacts do the opposite of "A" contacts.

COMMON ELECTRICAL DEVICES FOR THE MA BREAKER



- Close Coil and Trip Coil- The close coil closes the breaker electrically, and the trip coil opens the breaker electrically. The close and trip coils are usually the same physically and electrically.

COMMON ELECTRICAL DEVICES FOR THE MA BREAKER



Reset Relay

The Reset Relay consists of 2 sets of contacts, 1 N/C and 1 N/O. The Reset Relay takes the place of the Latch Check switch and provides a permissive path for the close signal.

COMMON ELECTRICAL DEVICES FOR THE MA BREAKER



- 88 Switches

There are three 88 switches on the MA breaker, with 1 N/C and 1 N/O contact on each switch.

COMMON ELECTRICAL DEVICES FOR THE MA BREAKER



- The 88-1NC is in the motor circuit and is used to start the motor when the springs are DISCHARGED and stop the motor when the springs are fully CHARGED.
- The 88- 1NO and provides a permissive path for the close circuit when the springs are fully CHARGED.
- The 88-2NC is in the close control lockout circuit.
- The 88-2NO energizes an indicator light when the springs are fully CHARGED.
- The 88-3NC is in series with 88-1NO, holding the close control circuit open.
- The 88-3NO introduces a resistor into the motor circuit to slow it down when the springs are CHARGED.

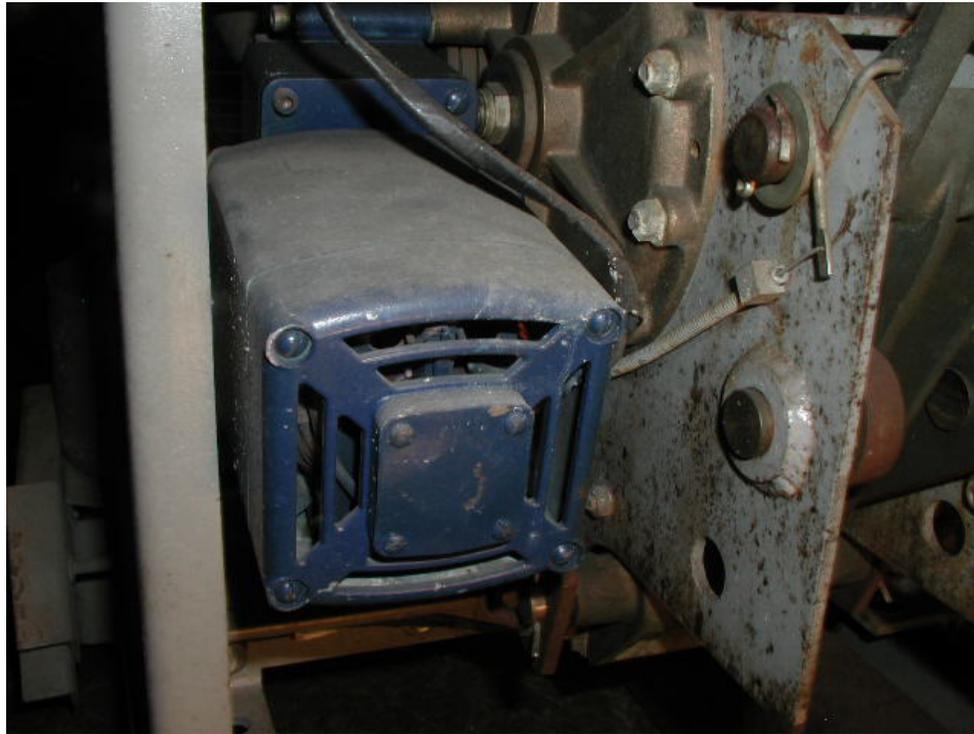
COMMON ELECTRICAL DEVICES FOR THE MA BREAKER



- Resistor slows the motor down after the springs are fully CHARGED. It is mounted on the left rear of the chassis.

COMMON ELECTRICAL DEVICES FOR THE MA BREAKER

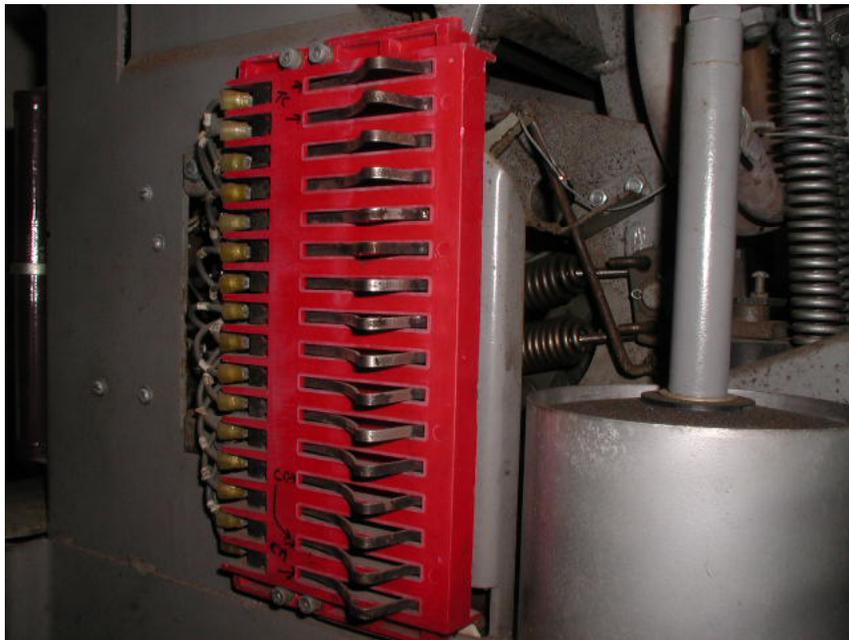
- Charging Motor



Charges the Closing Spring via a series of gears and cams.

COMMON ELECTRICAL DEVICES FOR THE MA BREAKER

- Secondary Disconnect



The Secondary Disconnect consists of a single assembly with 16 spring-loaded fingers arranged in vertical a row. The fingers slide onto a ramped receptacle in the cubicle. The Secondary is the electrical interface to operate the breaker between the cubicle and the breaker when the breaker is RACKED IN or RACKED OUT.

MECHANICAL AND SAFETY INTERLOCKS FOR THE MA CIRCUIT BREAKER



- Breaker Cell Coding Plate

Mounted on the left rear underside of the chassis, this coding plate or rejection bracket, keeps breakers of dissimilar ratings from being RACKED IN to the wrong cubicle.

MECHANICAL AND SAFETY INTERLOCKS FOR THE MA CIRCUIT BREAKER



- Floor Tripping and Spring Release Interlock

The Spring Discharge Interlock also actuates the Tripping lever when the breaker hits a stop plate in the cubicle. A common linkage works to safely DISCHARGE the Closing spring when the breaker is RACKED IN or RACKED OUT by a foot lever on the front middle of the breaker chassis.

Operating Mechanism for the MA Breaker



- The MA had a solenoid-operated mechanism but the nuclear plants that have MA breakers were all built after these breakers were built. There are several styles of stored energy operated mechanism designs for the MA breakers such as the SE-4 and 515-1.

COMMON FAILURE MODES FOR THE MA BREAKER



- The Allis Chalmers or Siemens Type circuit breakers are a low population breaker in the Nuclear Industry we believe only 2 plants use stored energy ACB breakers. There are very few specific reports on these breaker types due to the low population. The breakers would be prone to the same general failure modes that are common to most breakers that have generated reportable issues.

COMMON FAILURE MODES FOR THE MA BREAKER



- Just behind the Stationary Arcing contact on each phase is a ceramic flash block. Due to its proximity to the contact, the force of repeated operations usually cracks the block. Damage has been noted due to Arc chute misalignment and handling as well.
- The barriers are solid and with no alignment issues they hold up well. Over time chips, cracks and burns may warrant replacement on an as needed basis.
- The horizontal insulator plate that incorporates the Puffer tubes over the top of the Operator Assembly is very thin and doesn't hold up well to adverse conditions. Warping, cracks and holes are common failures.
- The Puffer Tubes themselves are partially surgical tubing and can dry out and become brittle and prone to cracking.
- Alignment issues can lead to more significant damage to barriers, frame and Primary disconnects. Alignment issues also can damage the MOC switch actuator or ground assembly.